

DOCUMENT-IDENTIFIER: US 5705685 A

TITLE: Conversion of alkanes to unsaturated carboxylic acids

BSPR:

The catalysts useful in the process of the present invention have the general formula $H_{\cdot e} (X_{\cdot k} M_{\cdot m} M'_{\cdot n} O_{\cdot y})_{\cdot e}$ where X, the central

or hetero atom, is a Group IIIB, IVB, VB, VIB or transition element, such as

phosphorus, silicon, gallium, aluminum, arsenic, germanium, boron, cobalt,

cerium, praseodymium, uranium and thorium; M, the first framework metal is molybdenum, tungsten, vanadium or combinations thereof; M', the second framework metal, is different from M and is independently zinc or a transition metal, such as titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, manganese, rhenium, iron, cobalt, nickel,

ruthenium, rhodium, palladium, osmium, iridium, platinum, copper, zinc or combination thereof; k is 1 to 5; m is 5 to 17; n is 1 to 3; y is 18 to 59; and e is the charge of the anion of the heteropolyacid; or a polyoxoanion of such heteropolyacid. When n is 1, M' is other than molybdenum, tungsten or vanadium.

BSPR:

In one embodiment, the catalysts useful in the present invention have the general formula $H_{\cdot e} (X_{\cdot k} M_{\cdot m} M'_{\cdot n} O_{\cdot y})_{\cdot e}$ where X, the

central or hetero atom, is a Group IIIB, IVB, VB, VIB or transition element, such as phosphorus, silicon, gallium, aluminum, arsenic, germanium, boron,

cobalt, cerium, praseodymium, uranium and thorium; M, the first framework metal

is molybdenum, tungsten, vanadium or combinations thereof; M', the second framework metal, is different from M and is independently zinc or a transition metal, such as titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, manganese, rhenium, iron, cobalt,

nickel,
ruthenium, rhodium, palladium, osmium, iridium, platinum, copper, zinc or
combination thereof; k is 1 to 5; m is 5 to 17; n is 1 to 3; y is 18 to 59; and
e is the charge of the anion of the heteropolyacid; or a polyoxoanion of such
heteropolyacid. When $n=1$, the second framework metal, M' , is other than
molybdenum, tungsten or vanadium.